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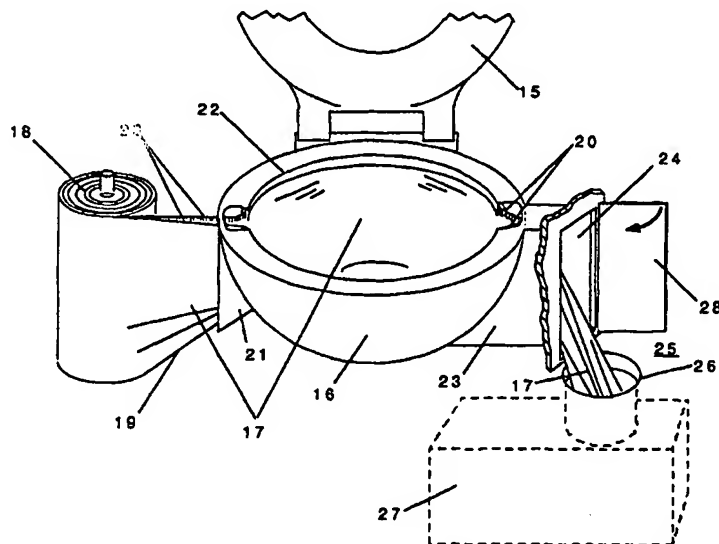
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(21) International Application Number: PCT/US95/03004 (22) International Filing Date: 13 March 1995 (13.03.95) (30) Priority Data: 9405323.8 16 March 1994 (16.03.94) GB (71) Applicant (for all designated States except US): WATER-STATE LIMITED [GB/GB]; Atlanta, Trent Lock, Nottingham NG10 2FY (GB). (72) Inventors; and (75) Inventors/Applicants (for US only): HAWKINS, Robert, D. [US/GB]; Atlanta, Trent Lock, Nottingham NG10 2FY (GB). HAWKINS, James, A. [US/GB]; Atlanta, Trent Lock, Nottingham NG10 2FY (GB). (74) Common Representative: HAWKINS, Robert, D.; Atlanta, Trent Lock, Nottingham NG10 2FY (GB).		(81) Designated States: AM, AU, BB, BG, BR, BY, CA, CN, CZ, EE, FI, GE, HU, JP, KG, KP, KR, KZ, LK, LR, LT, LV, MD, MG, MN, MX, NO, NZ, PL, RO, RU, SG, SI, SK, TJ, TT, UA, UG, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ, UG).  Published With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.	

(54) Title: DRY TOILET



(57) Abstract

A dry toilet with a disposable lining material can be operated at lower cost and be more portable if the lining material (17) is supplied as a substantially continuous sheet from a roll (18) and passes transversely through the toilet bowl (16). The toilet bowl (16) is adapted to receive the sheet liner through a side entrance aperture (21) and to remove the soiled sheet liner together with the contained waste through a side exit aperture (23). A concealed conveyance apparatus (27) arranged beneath the rim (22) of the toilet bowl (16) holds and advances the opposed edges (20) of the sheet liner (17) and thereby drapes the opened sheet liner (17) close to the inner surfaces of the toilet bowl (16) while simultaneously removing the soiled sheet liner (17) through an opening (24) with a door (28) for disposal into a drain (26).

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## DRY TOILET

### Technical Field

This invention relates to improvements in dry toilets and particularly to dry toilets with disposable lining.

### Background Art

5 Dry toilets have no water to convey waste away or to clean toilet surfaces and therefore various earlier patents describe bags or tubes to fit within a dry toilet to contain the waste or to convey the waste to a place of storage or disposal. Toilets using a vertically fed flexible tube to line the bowl have been described in UK patent specifications GB 1,525,613 and GB 2,160,417. In these references the tube used to line the toilet bowl is stored as a folded ring  
10 around the outside of the toilet bowl which is sequentially unfolded as the tube is pulled over the rim and down inside the bowl. The tube is pinched or sealed closed at the bottom of the bowl to contain the waste and also to prevent odors escaping from the previously used lower portion of the tube that has been deposited beneath the bowl.

This method of lining a toilet with a vertical tube has disadvantages which have limited the  
15 commercial exploitation of toilets employing this principle. An excess of tube material is required for each flush which makes the toilet expensive to operate. To be folded and stored outside the bowl, the tube diameter has to be much larger than the effective inside diameter of the bowl. This surplus of material makes large folds which project within the bowl thus reducing the bowl volume and causing the soiling of surfaces much closer to the seat than one  
20 expects from a conventional toilet. Furthermore, whereas a very thin material would be adequate to protect bowl surfaces, the tube material has to be relatively thicker to contain the waste in an odor free manner and to prevent leakage while it is stored below the toilet. The combination of excess thickness and excess diameter limits the amount of tube material that can be stored in the small space around the toilet bowl thus requiring the toilet to be restocked at  
25 more frequent intervals than would normally be desired. Also, the storage of tube material around the toilet results in having to locate the bowl and the seat further back from the front of the toilet enclosure making it uncomfortable for short people and children to sit on.

Another disadvantage of the vertical tube toilet is that the total height required for the bowl, the feeding and sealing mechanism beneath the bowl and the storage space below that is greater  
30 than the height of a conventional toilet and, therefore, in practice toilets of this type often project below the floor which prohibits their use as portable appliances and makes removal of the waste more difficult.

### Disclosure of Invention

These disadvantages that are inherent in tube lined toilets can be overcome by the present  
35 invention which, instead of using a continuous tubular liner, uses a continuous sheet liner and which, instead of feeding the liner through the bowl vertically, feeds the liner through the bowl

horizontally. Horizontal feed allows the supply of liner material and the waste storage container to be located independently of the bowl in spaces where there is more room and this results in larger storage capacity for both liner material and waste.

5 With no liner material stored in front of the bowl the seat can be located in a more comfortable forward position. Without the constraints imposed by the dimensions of the plastic tube and the need to pinch it closed at the bottom end, the bowl can be a more conventional depth and height which can then be easily incorporated into portable toilets.

10 With horizontal feed the draped liner sheet conforms closely to the bowl shape without folds in the front to back section where clearance is critical. It also conforms closely on the sides partly due to the way the liner sheet is guided and partly due to the much thinner liner material that can be used. The thinner liner is acceptable because the liner does not have to serve the added purpose of sealing and packaging the waste for storage. This can be done by other devices more effectively. The thinner liner can be supplied in relatively large quantities on a roll which is much less expensive than the specially folded thicker liner required for tube lined  
15 toilets.

According to a preferred aspect of the present invention there is provided a dry toilet with disposable lining comprising; a supply of liner material in the form of a substantially continuous length of sheet, a toilet bowl with walls adapted by means of a side entrance aperture and a side exit aperture for the transverse passage through the bowl of the sheet, a conveyance apparatus  
20 deployed around the rim of the bowl with means for holding, advancing, separating, rejoining and releasing the opposing edges of the sheet and thereby draping that portion of the sheet to form a lining close to the inner surfaces of the bowl, a means of actuating the conveyance apparatus to advance the liner sheet a horizontal distance that will cause a soiled portion of the sheet to be removed from the bowl through the side exit aperture and be replaced with a clean  
25 portion of sheet from the supply, an opening into an enclosure beyond the exit aperture through which the soiled sheet passes for disposal or storage after being released by the conveyance apparatus, said opening may be equipped with an automatic closure to prevent the escape of odors when the sheet is not in motion, a means for exhausting air from within the bowl beneath the sheet to assist the sheet to conform to the shape of the bowl, and a cover adapted to  
30 provide for a toilet seat and further adapted to enclose, protect or support, in cooperation with other structure, the aforesaid operating components.

Further according to a preferred aspect of the present invention the said conveyance apparatus might, for example, comprise two separate but synchronised and horizontally supported belt drives, each belt transporting one edge of the sheet and each belt traversing one  
35 half of the toilet bowl rim, a series of pulleys and guides to constrain the belts to follow the prescribed path, short pins projecting at intervals from the outer surface of the belts to penetrate and hold the edge of the sheet, said pulleys and guides on the outer surface of the belt having grooves to clear the projecting pins while pressing the edges of the sheet against the belt, a

tensioning means to assist the accurate alignment of the edges of the sheet when engaging with the belt drive, brackets to support the conveyance apparatus in alignment with the toilet bowl, other transmission, linkage and controls as might ordinarily be required to propel the conveyance apparatus by mechanical lever or electric motor and a fan or bellows as may be  
5 required to exhaust air from beneath the toilet bowl liner.

Sheet material in the form of plastic film can be made very thin, eg 10 microns thick, and still remain adequately strong and impervious to liquids. A 150 mm diameter roll of center folded, polyethylene film, 10 microns thick would hold enough material for 1500 flushes of a standard size toilet bowl. This can be compared with a maximum of 120 flushes that can  
10 normally be obtained from the specially folded tube that surrounds the bowl of a vertical tube toilet. Frequently used public toilets would be uneconomical if servicing was necessary after every 120 flushes.

Further, as may be preferred for some applications of the present invention the liner sheet could be composed of materials which are either biodegradable or are water soluble in order to  
15 aid their ultimate disposal. In this respect water soluble plastic films such as poly(ethylene oxide) have been used for some years to contain dry substances intended to be dissolved in water without the need to open the package. In a more recent development a water soluble film base has been combined with a thin layer that is nonstructural and impervious to water. This type of material could be used to contain and package moist toilet waste inside but would  
20 dissolve when the package was disposed of in the presence of water on the outside. Alternatively, there are other materials that can be fabricated into water soluble films such as polyvinyl alcohol which according to the formulation can be made to dissolve in water only above a predetermined temperature. This type of sheet material might be employed with this invention in cooperation with a heated holding tank.

#### 25 Brief Description of Drawings

The invention will be further described by way of example only, with reference to the accompanying and purely diagrammatic drawings, in which:

Figure 1 is a simplified perspective view showing elements of the dry toilet which illustrate the principle of the invention;

30 Figure 2 is a front section elevation through the toilet bowl;

Figure 3 is a top view of the toilet with covers partly removed to show a liner conveyance apparatus;

Figure 4 is a section detail of part of the liner conveyance apparatus, and

Figure 5 is a section detail of another part of the liner conveyance apparatus.

#### 35 Best Mode for Carrying Out Invention

The dry toilet shown in Figure 1 has the toilet seat 15 raised to reveal the bowl 16 which is lined with a thin sheet 17 supplied from a roll 18. The sheet 17 is folded in the center. The fold 19 is lowermost and the edges 20 of the sheet 17 are uppermost when entering the side of the

toilet bowl 16 through an entrance channel 21. At the top of the entrance channel the sheet edges 20 are separated by a conveyance apparatus which is concealed beneath the rim 22 of the bowl 16. The separated edges 20 are each conveyed halfway around opposite sides of the rim 22 to an exit channel 23. In the middle of the bowl 16 the sheet edges 20 are widely separated  
5 which unfolds the sheet 17 and allows it to cover the sides and the bottom of the bowl 16. At the top of the exit channel 23 the edges 20 of the sheet are brought close together again by the conveyance apparatus and then released. After release, the sheet 17, assisted by gravity and possibly air flow, passes through an opening 24 into an enclosed space 25 and thence into a drain 26 leading to a container 27 where processing or removal of the waste together with the  
10 soiled liner sheet can be implemented.

To contain odors, the opening 24 can be kept closed by a door 28 except when the sheet 17 is being moved to empty the bowl 16 of waste. The door 28 could have a soft sealing gasket around its perimeter which when pressed against the thin liner sheet 17 would effect an air tight closure. Alternatively the door 28 might not be necessary if the container 27 was equipped with  
15 exhaust fan ventilation to the outside air as is often done with dry toilets. Air would then be drawn through the opening 24 and into the enclosure 25 which would prevent odors from escaping. The passage of the sheet 17 through the bowl 16 is further illustrated by reference to Figure 2 which shows a section through the middle of the bowl and along the axis of the entrance channel 21 and the exit channel 23. To aid the draining of liquid wastes both the  
20 entrance channel floor 29 and the exit channel floor 30 slope downwards in the direction of the drain 26. This drainage slope prevents liquid waste from accumulating in the bottom of the bowl where it might otherwise result in splashing or where it could contaminate clean liner sheet 17 residing within the entrance channel 21. The drainage slope also allows the bowl to be easily washed and rinsed in the unlikely event that the lining sheet becomes damaged and leaks.

By referring to Figure 3, the positions of entrance channel floor 29 and the exit channel floor 30 can be seen within the bowl 16. The entrance channel floor 29 need only be wide enough to clear the passage of the sheet 17 whereas the exit channel floor 30 must be wider in order to clear the passage of the soiled sheet containing solid waste. The door 28 is hinged on a shaft 31 which, as further illustrated in Figure 2, can project through the upper wall of the  
30 enclosure 25 and connect to a control arm 32. The control arm 32 can be linked to the toilet operating mechanism to open the door 28 when the toilet is being emptied.

Referring again to Figure 2, indentions 33 have been provided in the inner surface of the bowl 16 leading to exhaust holes 34 connecting through the wall of the bowl to a duct 35 wherein air pressure can be lowered by the action of a bellows or fan to cause the liner sheet  
35 material 17 to be sucked against the surface of the bowl 16. Such vacuum suction need only to be applied momentarily and would normally be relieved when the liner sheet is being conveyed through the bowl.

Also, in Figure 2 the seat 15 is shown lowered and resting on the rim 22 which has been

made integral with the cover 36 to conceal the conveyance apparatus 37 as well as other working components of the toilet.

A conveyance apparatus which could transport the sheet 17 around the perimeter of the bowl 16 will be described with reference to Figures 3, 4 and 5. Two synchronised timing belts 38 each forming a return loop are guided and driven along the perimeter of the bowl by timing belt pulleys 39. The belts are further guided on their outside surfaces by pulleys 40 with a radial groove 41 to provide clearance for the pins 42 which project from the outside surface of the belts 38 to pierce and hold the edges 20 of the sheet 17. Two other similarly grooved pulleys 43 located at the top of the entrance channel 29 press the incoming edges 20 of the sheet onto the projecting belt pins 42. To help maintain even tension of the sheet 17 as it is being fed into the pulleys 43 a roller 49 is positioned so as to maintain alignment of the sheet edges 20 along the central axis. To control the supply tension of the sheet 17 a friction device or other mechanical braking device could be adapted to the supply roll 18 or its spindle. After being conveyed along the bowl perimeter the sheet 17 is forced off the pins 42 by the constraint of the exit channel walls 44.

Along portions of the belts 38 where there are no grooved pulleys 40 it may be desirable to provide slotted guide surfaces 45, as shown in section in Figure 4, to prevent the sheet edges 20 from being pulled off the belt pins 42. Alternatively, instead of guide surfaces additional grooved pulleys could be provided. Guide surfaces 45 and pulleys 39, 40 and 43 are supported on mounting brackets 46 which in turn are fastened to the top edge of the bowl by studs 47. The rim 22 combined with cover 36 rests on pads 48 on the upper surface of the mounting brackets 46 thus shielding the conveyance apparatus 36 from user interference and contamination.

The two belts 38 can be synchronised, for example, by linking their respective timing belt pulleys 39 located at the entrance door 21 with matching spur gears. The spur gears could be located beneath the entrance channel floor 29 and connected by shafts to the belt pulleys 39 above. By similar additional mechanical linking the conveyance apparatus, the drain area door and the air exhaust means could be made to operate automatically with the force of a foot pedal or the power of a small electric motor.

CLAIMS

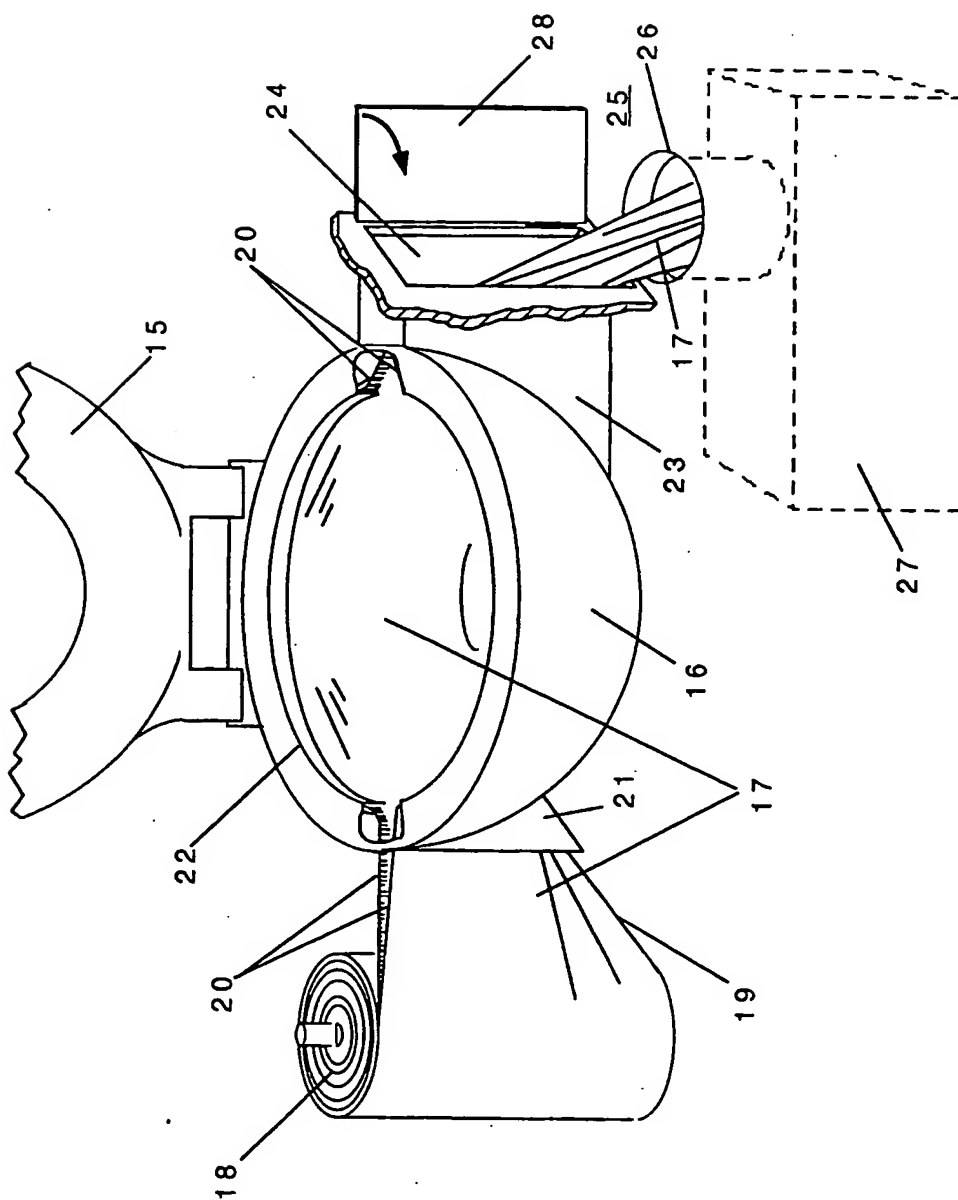
1. A dry toilet with disposable lining comprising; lining material in the form of a substantially continuous length of sheet, the sheet extending from a storage space, transversely through the toilet waste receptacle and into a disposal space, a portion of the sheet being shaped to form an open container within the toilet waste receptacle assisted by means for guiding and spacing the two opposed edges of the sheet, and with a means for intermittently moving the sheet in a horizontal direction leading from the storage space into the disposal space.
2. A dry toilet with disposable lining comprising; lining material in the form of a substantially continuous length of sheet, a conveyance apparatus arranged around the upper perimeter of the toilet waste receptacle, the conveyance apparatus having means for holding, advancing, separating, bringing together and releasing two opposite edges of the sheet and thereby draping the sheet to form an open container within the toilet waste receptacle, guide surfaces adjacent to the sheet to assist the formation of the container shape and a means of actuating the conveyance apparatus to advance the sheet a horizontal distance that will cause the soiled portion of the sheet to be removed from the toilet waste receptacle into a disposal space and to be replaced with a clean portion of sheet from a storage space.
3. A dry toilet with disposable lining comprising; a toilet bowl with walls adapted by means of a side entrance aperture and a side exit aperture for the transverse passage through the bowl of liner material in the form a substantially continuous length of sheet, a conveyance apparatus arranged around the upper rim of the bowl with means for holding, advancing, separating, bringing together and releasing two opposite edges of the sheet and thereby draping the sheet material to form a liner in the proximity of the inner surfaces of the bowl and a means of actuating the conveyance apparatus to advance the sheet a distance that will cause the soiled portion of the sheet to be removed sideways from the bowl into a disposal space and to be replaced with a clean portion of sheet from a storage space.
4. A dry toilet with disposable lining comprising; lining material in the form of a substantially continuous length of sheet, a toilet seat, a conveyance apparatus positioned in a horizontal plane beneath the toilet seat, the conveyance apparatus having means for holding, advancing, separating, bringing together and releasing two opposite edges of the sheet and thereby draping the sheet to form an open container beneath the toilet seat, guide surfaces adjacent to the sheet material to assist the formation of the container shape and a means of actuating the conveyance apparatus to horizontally advance the sheet a distance that will cause the soiled portion of the sheet to be removed from the area beneath the seat into a disposal space and to be replaced with a clean portion of sheet from a storage space.



5. A dry toilet with disposable liner according to claim 2, 3 or 4, wherein the conveyance apparatus includes one or more guided belts having projecting points along the belt face which in cooperation with opposing slotted surfaces pierce and hold the edges of the sheet.
6. A dry toilet with disposable liner according to claims 1, 2, 3 or 4, with closure means
- 5 across the opening into the disposal space to restrict the escape of odors when the sheet is not being transported.
7. A dry toilet with disposable liner according to claims 1, 2, 3 or 4, wherein air is exhausted from at least part of the space below the sheet material to assist the sheet to form a functional shape.
- 10 8. A dry toilet with disposable liner according to claims 1, 2, 3 or 4, wherein the sheet is supplied in a substantially continuous length rolled up in a cylindrical form.
9. A dry toilet with disposable liner according to claims 1, 2, 3 or 4, wherein the material content of the sheet assists its decomposition after disposal.

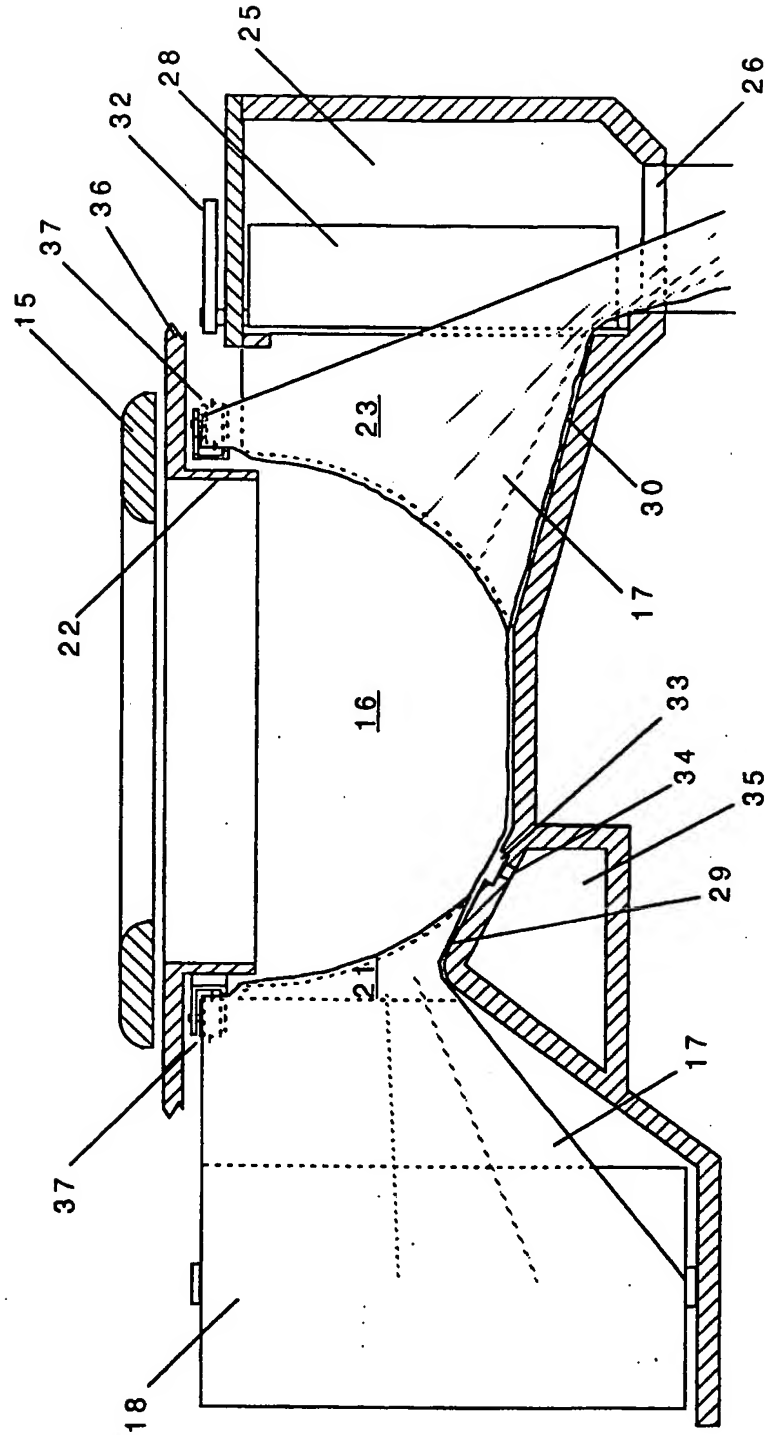
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FIG. 1



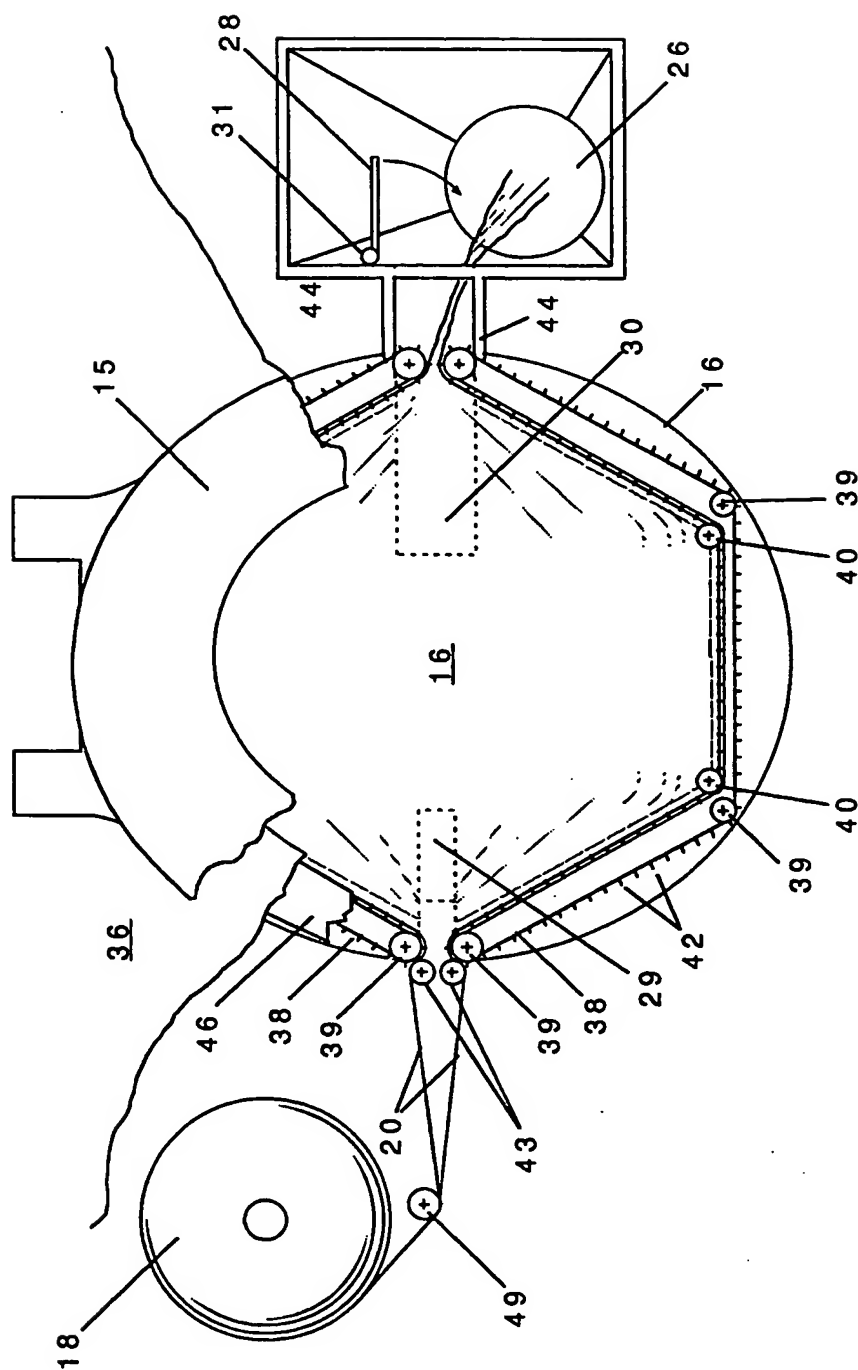
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FIG. 2



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**FIG. 3**



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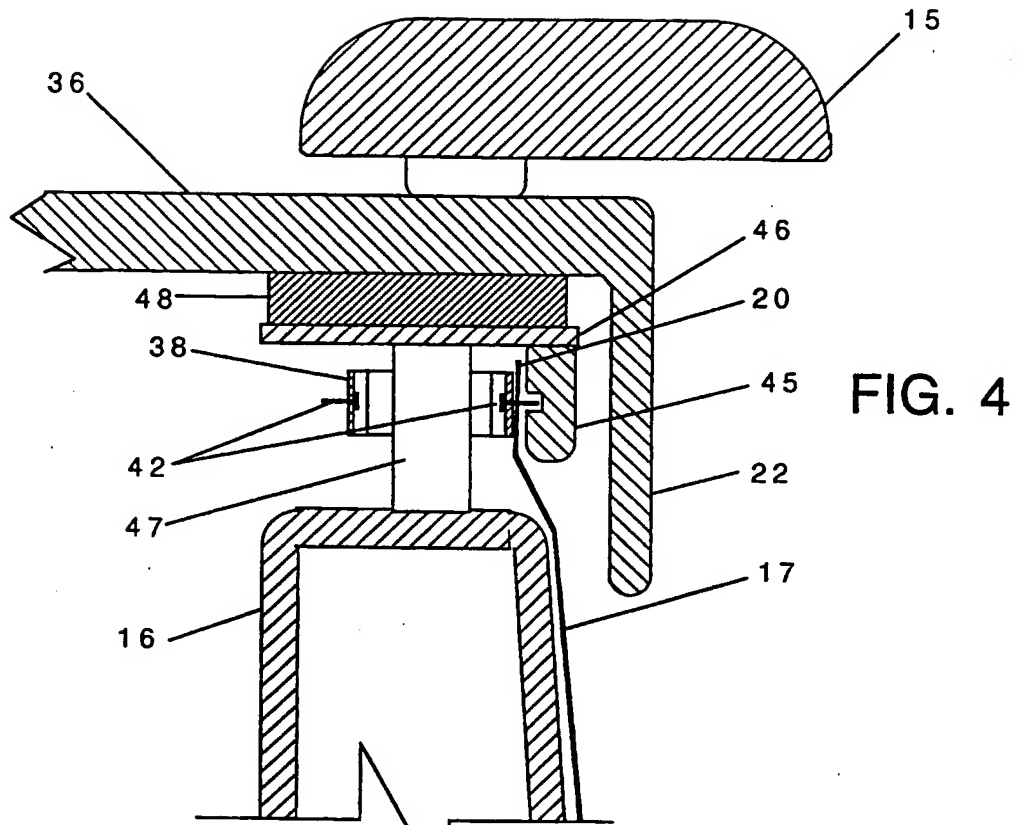


FIG. 4

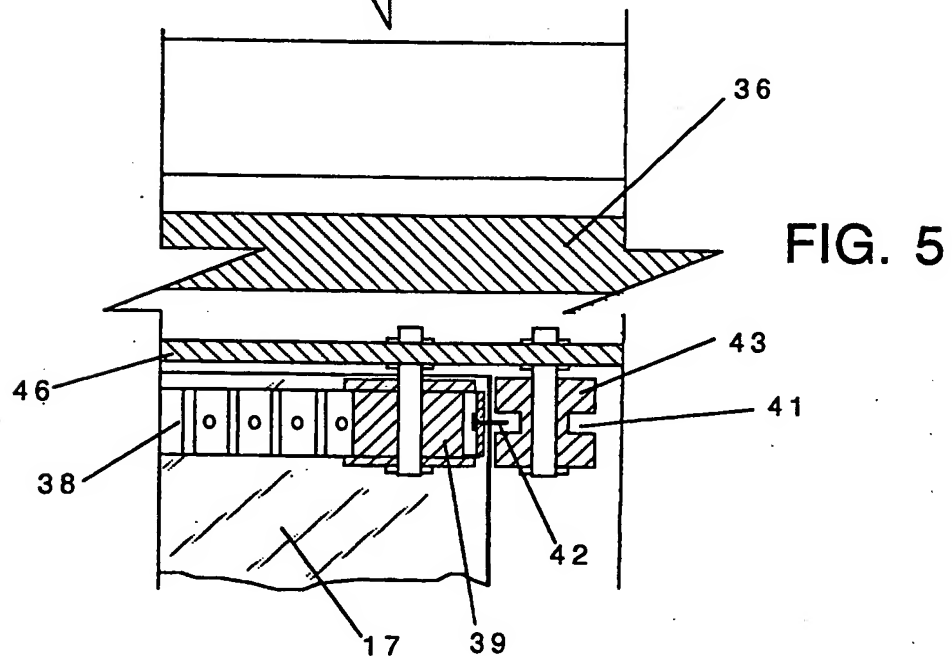


FIG. 5

## INTERNATIONAL SEARCH REPORT

 International application No.  
 PCT/US95/03004

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :A47K 11/02

US CL :4/484, DIG 18

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 4/484, DIG 18; 383/37

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ----- Y	US, A, 3,665,522 (BACKLUND ET AL.) 30 May 1972, see entire document.	1, 2, 7/1, 7/2, 8/1, 8/2 ----- 6/1, 6/2, 9/1, 9/2
X ----- Y	DT, A, 2,211,880 (HAAS) 20 September 1973, see entire document.	1, 6/1, 8/1 ----- 7/1, 9/1
Y	US, A, 3,675,250 (BENGTTSSON) 11 July 1972, see entire document.	7/1, 7/2
Y	US, A, 3,546,716 (LAUMANN) 15 December 1970, see entire document.	9/1, 9/2

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Date of the actual completion of the international search

10 MAY 1995

Date of mailing of the international search report

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PCT/US95/03004

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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Y	US, A, 3,763,502 (LAUMANN) 09 October 1973, see entire document.	9/1, 9/2
A	US, A, 1,967,581 (MACIAS) 24 July 1934, see entire document.	1-9/4
A	US, A, 4,627,117 (MORISHITA) 09 December 1986, see entire document.	8/1-8/4
A	US, A, 2,801,426 (LA GORCE ET AL.) 06 August 1957, see entire document.	1-9/4
A	US, A, 2,671,906 (POTTS) 16 March 1954, see entire document.	1-9/4
A	US, A, 3,619,822 (CARMICHAEL) 16 November 1971, see entire document.	1-9/4
A	US, A, 3,878,572 (ERIKSSON) 22 April 1975, see entire document.	1-9/4

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